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Macquarie Group Foundation Chair of Cerebral Palsy

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Interventions and Management

1. Severe neuromuscular scoliosis implicated by dysfunction of intrathecal Baclofen pump. Case report and literature review.
Panagopoulos D, Apostolopoulou K, Themistocleous M.

World Neurosurg. 2019 Nov 13. pii: S1878-8750(19)32863-3. doi: 10.1016/j.wneu.2019.11.027. [Epub ahead of print]

BACKGROUND: Complex spinal deformities are a common issue in pediatric patients with an underlying neurological diagnosis or syndrome. Management of neuromuscular scoliosis is an awesome responsibility as these patients present with the most challenging pathologies of the deformed spine. Besides surgical correction of the underlying deformity, intrathecal baclofen pump is considered to be effective in the management of the associated spasticity. CASE DESCRIPTION: We present the case of an eleven years old female who suffered an episode of severe ischemic encephalopathy with accompanied hydrocephalus and severe spastic quadriplegia. An intrathecal baclofen pump was inserted to manage spasticity and two years after, a very severe, decompensated spinal curvature developed. Additionally, malfunction of the pump was noticed and revision was decided along with open hemilaminectomy at L3-L4 level. The inability of cerebrospinal fluid to access the pump was intraoperatively verified, as no glow of cerebrospinal fluid through the intrathecal space could be documented, revealing blockage of cerebrospinal fluid flow. CONCLUSIONS: The association of cerebral palsy and relevant disorders with the relentless progression of scoliosis is analyzed, along with the possible offending mechanisms. The efficacy of intrathecal baclofen pump in controlling intractable spasticity associated with neuromuscular scoliosis is reviewed, as well as its potential implication in the accentuation of the clinical progression of neuromuscular scoliosis. Although it is an extremely infrequent situation, we have always to bear in mind the possibility that malfunction of an intrathecal baclofen pump could be related to obstruction of cerebrospinal fluid flow, due to the extreme severity of the curves that have been established during the course of, most probably untreated, neuromuscular scoliosis.

PMID: 31733394

2. Quantitative assessment of lower limbs gross motor function in children with cerebral palsy based on surface EMG and inertial sensors.
Chen X, Wu Q, Tang L, Cao S, Zhang X, Chen X.

Med Biol Eng Comput. 2019 Nov 21. doi: 10.1007/s11517-019-02076-w. [Epub ahead of print]

Taking advantage of motion sensing technology, a quantitative assessment method for lower limbs motor function of cerebral palsy (CP) based on the gross motor function measurement (GMFM)-24 scale was explored in this study. According to the motion analysis on GMFM-24 scale, we translated the assessment problem of GMFM-24 scale into a detection problem of different motion modes including static state, fall, step, turning, alternating gait, walking, running, lifting legs, kicking balls, and jumping. The surface electromyography (sEMG) electrodes and inertial sensors were adopted to capture motion data, and

a framework integrating a series of detection algorithms was presented for the assessment of lower limbs gross motor function. Two groups of participants including 8 healthy adults and 14 CP children were recruited. A self-developed data acquisition equipment integrating 24 sEMG electrodes and 9 inertial units was adopted for data acquisition. A platform based on two laser beam sensors was used to perform cross-border detection. The parameters/thresholds of motion detection algorithms were determined by the data from healthy adults, and the lower limbs gross motor function evaluation was conducted on 14 CP children. The experimental results verified the feasibility and effectiveness of the proposed quantitative assessment method. Compared to the clinical assessment score based on GMFM-24 scale, 90.1% accuracy was obtained for evaluation of 303 tasks in 14 CP children. The objective motor function assessment method proposed has potential application value for the quantitative assessment of lower limbs motor function of CP children in clinical practice. Graphical abstract The algorithm framework for the assessment of lower limbs gross motor function. Using the GMFM-24 scale as the evaluation standard, a quantitative evaluation program for the lower limbs gross motor function of CP children based on motion sensing technology was proposed.

PMID: 31754980

3. Reliability and measurement error of multi-segment trunk kinematics and kinetics during cerebral palsy gait.
Kiernan D, Simms CK.

Med Eng Phys. 2019 Nov 12. pii: S1350-4533(19)30218-8. doi: 10.1016/j.medengphy.2019.11.002. [Epub ahead of print]

Children with cerebral palsy (CP) have been shown to have altered trunk movements during gait resulting in increased loads at the lower lumbar spine. Detailed assessment is possible using 3D gait analysis. However, reliability and quantification of measurement error have not been established. The aim of this study was to evaluate test-retest reliability of thorax and lumbar segment kinematics and L5/S1 kinetics during gait in children with CP. Eight children with CP participated in this study with repeat assessments conducted within 1 week. Reliability was assessed using the one-way random ICC, standard error of measurement and an examination of extrinsic-to-intrinsic variability. Thorax kinematics demonstrated mixed level of reliability with SEM values ranging from 5.94o to 1.15o. Lumbar kinematics demonstrated poor-to-good reliability with the largest SEM values for peak lumbar flexion at 4.14o. L5/S1 moment values demonstrated only poor to good test-retest reliability while L5/S1 reactive forces demonstrated poor to excellent test-retest reliability.This study provides estimates of reliability and change needed to exceed measurement error. While reliability was mixed and some measures for thorax movement were above 5o, stated as a measure of acceptable error, the results of this study support the use of these measures in children with CP.

PMID: 31732393

4. Relationship between changes in motor capacity and objectively measured motor performance in ambulatory children with spastic cerebral palsy.
Halma E, Bussmann JBJ, van den Berg-Emons HJG, Sneekes EM, Pangalila R, Schasfoort FC; SPACE BOP study group.

Child Care Health Dev. 2019 Nov 22. doi: 10.1111/cch.12719. [Epub ahead of print]

BACKGROUND: Different interventions are offered to children with cerebral palsy (CP) to improve the activity domain of the international classification of functioning (ICF). In therapy settings, the focus is mostly on motor capacity, but the ultimate goal is to improve motor performance. We therefore examined if changes in motor capacity outcomes are accompanied by changes in objectively measured motor performance after a three-month intensive treatment period in ambulatory children with CP. METHODS: A secondary analysis on prospective clinical trial data was performed using multivariate linear regression. Sixty-five children (37 boys, 28 girls) with spastic CP, mean age 7 years and 3 months, GMFCS level I-III, were involved in a distinct three-month intensive treatment period. Motor capacity (Gross Motor Function Measure (GMFM), functional muscle strength (FMS), and walking speed (WS)) and motor performance (using three Actigraph-GT3X+-derived outcome measures) were measured at baseline, 12 weeks and 24 weeks. RESULTS: No significant associations were found for any of the change scores (Δ12) between motor capacity and motor performance after a 12-week intensive treatment period. After 24 weeks, Δ24 FMS (p=0.042) and Δ24 WS (p=0.036) were significantly associated with changes in motor performance outcome measure percentage of time spent sedentary (Δ24 %sedentary). In this model, 16% of variance of Δ24 %sedentary was explained by changes in motor capacity (p=0.030). CONCLUSIONS: Changes in motor capacity are mostly not accompanied by changes in objectively measured motor performance after an intensive treatment period for ambulatory children with CP. These findings should be taken into account during goal setting and are important to manage expectations of both short- and longer term effects of treatment programs.

PMID: 31756281

5. How does applying of one or two orthosis influence gait parameters of children with hemiplegia?
Boryczka-Trefler A, Syczewska M, Stępowska J.

Acta Bioeng Biomech. 2019;21(2):95-100.

The aim of this study was to evaluate how wearing one or two orthoses influence the gait parameters in children with hemiplegia. Four children with hemiplegic cerebral palsy participated in the study. Patients were from 3 to 7 years old; one girl and three boys; one patient with right side hemiplegia, three patients with left side hemiplegia. Patients underwent the VICON MX system gait analysis three times (sessions): one with bare feet, the other two with shoes and orthoses: one with orthoses used unilaterally on palsied limb, one with orthoses used bilaterally. The following gait parameters were analyzed: velocity, cadence, pelvis tilt, range of pelvic movement in sagittal plane, separately for affected and non-affected side: step length, stance time (as a percentage of the gait cycle), range of hip movement in sagittal plane, knee flexion at initial contact, maximum knee flexion in swing phase. Results of the study showed which and how many gait parameters changed while wearing one in comparison with two orthoses. The results did not give a clear indication which condition is better: wearing one or two orthoses, however they suggest that when the orthotic devices are considered for patients with hemiplegic cerebral palsy, the objective, instrumented gait analysis can be used to take the best decision whether one or two orthoses should be prescribed.

PMID: 31741476

6. Modified split tendon transfer of posterior tibialis muscle in the treatment of spastic equinovarus foot deformity: long -term results and comparison with the standard procedure.
Aleksić M, Baščarevic Z, Stevanović V, Rakočević J, Baljozović A, Čobeljić G.

Int Orthop. 2019 Nov 19. doi: 10.1007/s00264-019-04443-6. [Epub ahead of print]

INTRODUCTION: Split tendon transfer of tibialis posterior (SPOTT) is a treatment option for the hindfoot varus deformity in patients with cerebral palsy (CP). The purpose of this study was to present the long-term results of the newly modified SPOTT procedure developed by our senior author and compare it with the standard SPOTT technique in equinovarus foot deformity due to CP. METHOD: Our retrospective cohort study included patients with spastic foot deformity due to CP treated with the standard or modified SPOTT technique. Patients' age at the time of the surgery was ≥ five years with follow-up period of at least four years. Surgical outcomes were evaluated using Kling's criteria during the patient's last follow-up visit. RESULTS: The analysis included 124 patients (146 feet), where 105 feet were treated by the standard SPOTT technique and 41 feet by the modified SPOTT technique. Patients' median age at the time of the surgery was 11 years. Patients were followed-up for a median period of eight years during which the modified SPOTT technique showed significantly better surgical outcomes compared with the standard group (excellent/good results in 38 feet, 92.7%, vs. 79 feet, 75.2%, p = 0.02). Two groups of patients did not significantly differ in GMFCS level, age at the time of the surgery, or patient gender. There was similar distribution in CP patterns in the standard and modified groups; spastic hemiplegia was the most prevalent form, followed by spastic diplegia and spastic paraplegia. Overall, better surgical success was achieved in patients with GMFCS levels I-III (100%, 94.8%, and 69.8%, respectively). SPOTT procedure failure was frequently noticed in patients with GMFCS level IV (90.9%). CONCLUSION: The modified SPOTT procedure demonstrated efficiency and safety in patients with equinovarus foot deformity due to CP during the long-term follow-up. Compared with the standard procedure, the newly modified SPOTT technique showed significantly better surgical outcome, irrespective of the patients' gender, age, initial GMFCS level, and CP type.

PMID: 31740994

7. Impact of Resistance Therapy on Motor Function in Children with Cerebral Palsy: A Systematic Review and Meta-Analysis.
Collado-Garrido L, Parás-Bravo P, Calvo-Martín P, Santibáñez-Margüello M.

Int J Environ Res Public Health. 2019 Nov 15;16(22). pii: E4513. doi: 10.3390/ijerph16224513.

Cerebral palsy is one of the main causes of disability in childhood. Resistance therapy shows benefits in increasing strength and gait in these patients, but its impact on motor function is not yet clear. The objective was to analyze the impact of resistance therapy on the improvement in the motor function using a review and meta-analysis. A comprehensive literature research was conducted in Medline (PubMed), Institute for Scientific Information (ISI) Web of Knowledge, and Physiotherapy Evidence Database (PEDro) in relation to clinical trials in which resistance therapy was used and motor function was assessed. Twelve

controlled clinical trials and three non-controlled clinical trials (only one intervention arm) studies were identified. In terms of pre-post difference, the overall intra-group effect was in favor of resistance therapy intervention: standardized mean difference (SMD) = 0.37, 95% confidence interval (CI) = 0.21 to 0.52, $p < 0.001$ (random-effects model), with moderate heterogeneity ($I2 = 59.82\%$). SMDs were also positive by restricting to each of the analyzed scales: SMD = 0.37, 1.33, 0.10, and 0.36 for Gross Motor Function Measure (GMFM), Lateral Step Up (LSU), Time Up and Go (TUG), and Mobility Questionnaire (MobQue) scales, respectively. Regarding the difference between groups, the results showed a high heterogeneity ($I2 < 99\%$), with the mean difference (MD) also favorable for the GMFM scale: MD = 1.73, 95% CI = 0.81 to 2.64, $p < 0.001$ (random-effects model). Our results support a positive impact of resistance therapy on motor function. Further studies should delve into the clinical relevance of these results.

PMID: 31731636

8. Are exercise interventions effective in patients with cerebral palsy? A Cochrane Review summary with commentary.
Gimigliano F.

Dev Med Child Neurol. 2019 Nov 17. doi: 10.1111/dmcn.14400. [Epub ahead of print]

PMID: 31736047

9. The effects of an individualized health-risk report intervention on changes in perceived inactivity-related disease risk in adults with cerebral palsy.
McPhee PG, Gorter JW, MacDonald MJ, Martin Ginis KA.

Disabil Health J. 2019 Nov 11:100868. doi: 10.1016/j.dhjo.2019.100868. [Epub ahead of print]

BACKGROUND: To explore the effect of an individualized health-risk report intervention on changes in perceived disease risk in adults with cerebral palsy (CP). HYPOTHESES: 1. Perceived disease risk from those at risk for heart disease, obesity, and/or diabetes will be greater compared to those not at risk following receipt of health-risk information; 2. There will be a positive relationship between risk measures of inactivity-related diseases and post-intervention perceived disease risk; and increases in perceived disease risk will predict increases in physical activity (PA). METHODS: An individualized health-risk report was delivered to each participant. Three brief telephone interviews were conducted over two weeks to measure perceptions of disease risk and PA. Two-way repeated measures ANOVA and regression analyses were performed to address the study objectives. RESULTS: Thirty-one adults with CP (Gross Motor Function Classification System level I-V; age, 33.7 ± 13.1y) completed the study. The health-risk report did not change the perceived risk of any inactivity-related disease. We found significant main effects for hypertension ($p = 0.02$; 95% CI [-1.1, -0.5]) on perceived risk of heart disease, and for waist circumference ($p < 0.01$; 95% CI [-1.3, -0.3]) and BMI ($p < 0.01$; 95% CI [-1.3, -0.3]) on perceived risk of obesity. PA did not change following the intervention. CONCLUSIONS: An individualized health-risk report intervention did not change perceived risk of inactivity-related disease or change PA behaviour. Blood pressure, waist circumference and BMI were salient measures of health that affected perceived disease risk in adults with CP; these health variables should be assessed and managed through clinical encounters.

PMID: 31740388

10. A Preliminary Evaluation of Energy Efficiency for Children with Cerebral Palsy for Driving A Manual Wheelchair and Walking: Use of the Total Heart Beat Index.
Abe H, Inoue K, Kozuka N.

Dev Neurorehabil. 2019 Nov 19:1-7. doi: 10.1080/17518423.2019.1692947. [Epub ahead of print]

Aims: This study aims to compare the total heart beat index (THBI) in evaluating energy efficiency between using a manual wheelchair and walking for children with cerebral palsy (CP).Methods: The energy efficiency was measured in 21 participants with CP (mean age, 13.6 ± 3.4 years) who walk or drive a manual wheelchair using a square course. THBI was calculated as total number of heart beats during the exercise period/total distance traveled.Results: Significant differences in the THBI were observed between Gross Motor Function Classification System (GMFCS) levels III and IV ($p = .049$, effect size = 1.60). No significant differences in THBI were observed between GMFCS levels II and III or between GMFCS levels II and IV ($p > .05$).Conclusions: The energy efficiency of children with CP who use a manual wheelchair in this study was equal to or better than that for walking.

PMID: 31739713

11. Reducing opioid usage: a pilot study comparing postoperative selective dorsal rhizotomy protocols.
Pao LP, Zhu L, Tariq S, Hill CA, Yu B, Kendrick M, Jungman M, Miesner EL, Mundluru SN, Hall SL, Bosques G, Thakur N, Shah MN.

J Neurosurg Pediatr. 2019 Nov 22:1-6. doi: 10.3171/2019.9.PEDS19398. [Epub ahead of print]

OBJECTIVE: Selective dorsal rhizotomy (SDR) is a surgical procedure used to treat spasticity in children with spastic cerebral palsy. Currently, there is a lack of work examining the efficacy of optimizing pain management protocols after single-level laminectomy for SDR. This pilot study aimed to compare the clinical outcomes of SDR completed with a traditional pain management protocol versus one designed for opioid dosage reduction. METHODS: The Texas Comprehensive Spasticity Center prospective database was queried for all patients who underwent SDR between 2015 and 2018. Demographic, surgical, and postoperative data for all patients who underwent SDR were collected from medical records. The study was designed as a retrospective study between the patient-controlled analgesia (PCA) and dexmedetomidine infusion (INF) groups with 80% power to detect a 50% difference at a significance level of 0.05. Patients in the INF group received perioperative gabapentin, intraoperative dexmedetomidine infusion, and scheduled acetaminophen and NSAIDs postoperatively. RESULTS: Medication administration records, pain scores, and therapy notes were collected for 30 patients. Patients who underwent SDR between June 2015 and the end of December 2017 received traditional pain management (PCA group, n = 14). Patients who underwent SDR between January 2018 and the end of December 2018 received modified pain management (INF group, n = 16). No patients were lost to follow-up. Differences in age, weight, height, preoperative Gross Motor Function Classification System scores, operative duration, hospital length of stay, and sex distribution were not statistically different between the 2 groups ($p > 0.05$). Analysis of analgesic medication doses demonstrated that the INF group required fewer doses and lower amounts of opioids overall, and also fewer NSAIDs than the PCA group. When converted to the morphine milligram equivalent, the patients in the INF group used fewer doses and lower amounts of opioids overall than the PCA group. These differences were either statistically significant ($p < 0.05$) or trending toward significance ($p < 0.10$). Both groups participated in physical and occupational therapy similarly postoperatively ($p > 0.05$). Pain scores were comparable between the groups ($p > 0.05$) despite patients in the INF group requiring fewer opioids. CONCLUSIONS: Infusion with dexmedetomidine during SDR surgery combined with perioperative gabapentin and scheduled acetaminophen and NSAIDs postoperatively resulted in similar pain scores to traditional pain management with opioids. In addition, this pilot study demonstrated that patients who received the INF pain management protocol required reduced opioid dosages and were able to participate in therapy similarly to the control PCA group.

PMID: 31756707

12. Intrathecal Catheter.
Di Napoli R, esposito g, Cascella M.
SourceStatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019-.
2019 Nov 12.
Intrathecal therapy began to emerge in the late 1970s when the World Health Organization (WHO) placed attention on a more careful treatment of cancer pain. Later on, the interest in the use of intrathecal catheters for intrathecal administrations of drugs increased after the clinical demonstration of the efficacy of intrathecal morphine. In 1978, indeed, Wang et al. and later, Ventafridda et al. demonstrated that subarachnoid injections of morphine attenuated pain in cancer patients.[1][2] The next step was the intrathecal administration of morphine through implantable reservoirs. The first to describe the use of an implantable pump for the administration of intrathecal drugs was Onofrio, in 1981, followed by several clinical cases and several clinical investigations.[3][4][5] With proven efficacy, intrathecal therapy quickly came into use for the management of intractable pain for both cancer and non-cancerous pain.[6] An intrathecal catheter can also be used to prevent post-dural puncture headache (PDPH) following an accidental dural puncture during epidural anesthesia (e.g., in parturients).[7] Through this approach, the catheter can be used to provide analgesia (local anesthetics) and gets removed after at least 24 hours. Finally, since 1984, intrathecal therapy has also been used for severe spasticity in individuals affected by multiple sclerosis (MS), spinal cord injury (SCI), cerebral palsy (CP), and in patients with acquired brain injury (stroke). In the management of spasticity, baclofen is the recommended pharmacological treatment of choice.[8] Attempts have also been made to use intrathecal baclofen for the treatment of tetanus spasticity.[9] In summary: The advantages of intrathecal therapy include better analgesia with fewer side effects and a lower dose of drugs administered as the drug is taken directly to the receptors with a good impact on severe spasticity in adults and children. The disadvantages include the risks associated with the procedure, infections, side effects of the drugs administered, and costs.

PMID: 31747197

13. Evaluation of Risk Factors for Cerebrospinal Leakage in Pediatric Patients With Cerebral Palsy Treated With Intrathecal Baclofen.

Imerci A, Rogers KJ, Miller F, Sees JP.

J Pediatr Orthop. 2019 Nov 14. doi: 10.1097/BPO.0000000000001472. [Epub ahead of print]

BACKGROUND: Insertion of an intrathecal baclofen (ITB) pump can provide significant benefits in patients with cerebral palsy (CP). However, there are little data describing the risk of complications. Specifically, there is a lack of data describing the incidence of cerebrospinal fluid (CSF) leakage and risk factors following ITB placement. The purpose of our study was to describe risk factors for developing CSF leak in pediatric patients with CP treated with ITB and to report the treatment and outcome of CSF leaks. METHODS: Following institutional review board approval, 720 ITB procedures in 341 children with CP were identified retrospectively over a 15-year study period. Patients' demographic characteristics, medical comorbidities, muscle tone patterns, feeding tube status, seizure history, inpatient events, ITB-related CSF leak and headache complaints and their management, and other complications were evaluated. RESULTS: Eighty-five (24.9%) patients experienced 90 CSF leak episodes over a follow-up time of 6.3±3.9 years. There were 72 episodes of headache as a result of CSF leakage in 61 (71.7%) of these 85 patients. There was a positive correlation between the risk of CSF leak and preoperative comorbidities such as epilepsy/seizure history, feeding tube, mixed type CP, and dystonic type CP. The risk of CSF leak after primary ITB administration was 5.8% (20/341), and the risk after secondary ITB procedures due to complications was 24.2% (32/132). There was no significant relationship between CSF leak and primary ITB (P=0.21), but the risk of CSF leak was positively correlated to the secondary ITB due to complications (P<0.05). CONCLUSIONS: CSF leak was fairly common (25% incidence), and it correlated with epilepsy/seizure history, feeding tube, mixed type CP, and dystonic type CP. Recurrent ITB procedures were a risk factor for CSF leak. Half of these patients had self-limited symptoms that improved with conservative medical treatment, and the epidural blood patch was successful in resistant cases. Successful treatment of CSF leakage complications allows patients to continue ITB. LEVEL OF EVIDENCE: Level III.

PMID: 31743290

14. Profiles of functioning of children with cerebral palsy in Finland: analysis of multi-professional family meetings.
Jeglinsky I, Kaakkuriniemi E, Veijola A, Kiviranta T.

Disabil Rehabil. 2019 Nov 22:1-7. doi: 10.1080/09638288.2019.1692080. [Epub ahead of print]

Purpose: To explore what aspects of and how the child's functioning are discussed during a multi-professional team meeting when planning goals and interventions for rehabilitation. Materials and methods: Multi professional rehabilitation meetings were videotaped, the discussions transcribed and all content related to the child's function was linked to the International Classification of Functioning, Disability and Health comprehensive Core Set for children with cerebral palsy. Results: Thirteen families gave their informed consent to participate. In nine meetings the child was present and one or two parents attended all meetings. The mean age of the children was 10 years (3-17 years). Functioning was described as wide-ranging and covered most components of the International Classification of Functioning, Disability and Health. Body structures were mentioned rarely, and of body functions, musculoskeletal functions were most commonly discussed. The focus was on activities and participation, the most discussed aspects being learning, applying knowledge and mobility. Conclusions: The results showed that both children and their parents were involved when rehabilitation was planned. The comprehensive ICF Core Set for children and young people with CP was in this study used to analyze the areas of functioning discussed, but could also be useful in clinical practice to identify relevant areas of functioning. IMPLICATIONS FOR REHABILITATION: Identifying areas of functioning facilitate communication among families and multi-disciplinary professionals during rehabilitation team meetings. Important areas of participation are overlooked during intervention planning meetings, which could be improved using ICF-based tools. The comprehensive ICF Core Set for cerebral palsy is a useful framework to identify areas of functioning in Finland.

PMID: 31755320

15. Executive functions and drawing in young children with cerebral palsy: Comparisons with typical development.
Freire TC, Osório AAC.

Child Neuropsychol. 2019 Nov 21:1-14. doi: 10.1080/09297049.2019.1694648. [Epub ahead of print]

There is evidence that school-aged children with cerebral palsy (CP) may present deficits in executive functions (EF) greater than would be expected considering their intellectual ability. However, no studies have focused on characterizing EF in this group at an earlier critical period - the preschool years. Furthermore, and given evidence from typically-developing (TD) children, deficits in EF are associated with potential detrimental effects on social and educational development - which can

include drawing. Our aim was to compare preschool children with CP, matched in chronological age and intellectual ability with a group of TD children, regarding their executive functioning and drawing abilities. In addition, we examined the relationships between these variables in each of the groups. Twenty-eight children were evaluated in executive functions and drawing tasks. Differences were found in some aspects of cognitive flexibility and inhibitory control, but not in working memory. Additionally, the quality of the drawings was significantly poorer in the CP group. In the TD group, there was an association between greater inhibitory control (but not cognitive flexibility or working memory) and drawing quality. In the CP group, although non-significant, medium-sized correlations were observed between drawing and several aspects of executive functioning. Overall, our results suggest more similarities than differences in the executive functioning of children with CP (and preserved cognitive ability) and TD children. However, there were still important between-group differences in their drawing abilities. There was also a distinct pattern of associations between drawing and executive functions in the clinical group.

PMID: 31752569

16. Transition-Age Young Adults with Cerebral Palsy: Level of Participation and the Influencing Factors.
Rožkalne Z, Mukāns M, Vētra A.

Medicina (Kaunas). 2019 Nov 14;55(11). pii: E737. doi: 10.3390/medicina55110737.

Background and Objectives: The aim of this study was to identify the level of participation in the context of the developmental transition from adolescence to adult life for young adults with cerebral palsy (CP) and the factors that had an influence on participation. Materials and Methods: Eighty-one young adults (16-21 years old) with CP and with normal or slightly decreased cognitive function participated in this study. Assessments were made using the Rotterdam Transition Profile (RTP) and the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0). In the binary regression model, levels of participation (RTP scores) were set as dependents and the level of disability (WHODAS 2.0 scores), age, and level of gross motor function were set as independent variables. Results: In the age group <18 years, in three out of seven RTP domains, less than 10% of participants were in phase 2 (experimenting and orientating toward the future), i.e., finance-7%, housing-7%, sexuality-4%. In the age group ≥18 years, 21% (education and employment), 56% (intimate relationships), and 59% (sexuality) of the participants were in phase 0 (no experience). Higher scores in WHODAS 2.0 domains showed positive associations with RTP domains, i.e., cognition with social activities, mobility with transportation, self-care with sexuality and transportation, and life activities with transportation. Age was positively associated with education and employment, finance, housing, and sexuality. Low motor function according to the Gross Motor Function Classification System (GMFCS) had negative associations with autonomy in social activities, sexuality, and transportation. Conclusions: Young adults with cerebral palsy showed low levels of autonomy in all domains of participation. When addressing a person's improvement in terms of their participation, the promotion of abilities in cognition, mobility, self-care, and life activities should be attempted. Age and gross motor function influenced autonomy in participation, but not in all domains.

PMID: 31739609

17. A systematic review and meta-analysis of the prevalence of sleep problems in children with cerebral palsy: how do children with cerebral palsy differ from each other and from typically developing children?
Horwood L, Li P, Mok E, Shevell M, Constantin E.

Sleep Health. 2019 Nov 15. pii: S2352-7218(19)30181-0. doi: 10.1016/j.sleh.2019.08.006. [Epub ahead of print]

BACKGROUND: Up to 85% of children with neurodevelopmental disorders have sleep problems, compared with 25% of typically developing children. Children with cerebral palsy (CP)may have risk factors (brain injury, physical disability, and comorbidities) that make them more likely to have sleep problems compared with typically developing children. OBJECTIVE: To determine prevalence of sleep problems in children with CP. METHODS: We conducted a systematic review and meta-analysis to report on the prevalence of sleep problems in children with CP, within subgroups (age, CP phenotype, presence of impairments [auditory, visual, and cognitive], and presence of epilepsy) and compared with control groups of healthy children. We searched eight relevant electronic databases from their respective start dates until September 2018. RESULTS: 23 full-text articles (n=2,908 children with CP) were included in the review. All studies were cross-sectional and examined caregiver-reported sleep measures. The Sleep Disturbance Scale for Children (SDSC) was the most commonly used questionnaire. No study met all Joanna Briggs Institute quality assessment criteria for prevalence studies; selection, coverage, classification, and/or confounding biases were present in all studies. Using a random effects model with a Freeman-Tukey double arcsine transformation, the pooled prevalence was 23.4% (95% confidence interval [CI] 18.8-28.4%; n=9 studies) for an abnormal total score on the SDSC and 26.9% (95% CI 21.5-32.7%; n=9 studies) for disorders of initiation and maintenance of sleep, the most prevalent sleep problem reported. For the studies that reported prevalence for control groups of healthy children (n=4 studies), sleep problems were generally more prevalent in the CP group. CONCLUSION: The prevalence of sleep problems in children

with CP is high. There is notable variability in the prevalence of sleep problems between subgroups of children with CP. Future studies using questionnaires validated in children with CP and objective measures (such as polysomnography or actigraphy) in well-described, large, broadly recruited samples are recommended.

PMID: 31740377

18. Pregnancy outcome in women with cerebral palsy: A nationwide population-based cohort study.
Sundelin HE, Stephansson O, Johansson S, Ludvigsson JF.

Acta Obstet Gynecol Scand. 2019 Nov 18. doi: 10.1111/aogs.13773. [Epub ahead of print]

INTRODUCTION: Cerebral palsy (CP) is a lifelong disorder with a high rate of comorbidities and complications. We hypothesized that women with CP are at increased risk of adverse pregnancy outcome. MATERIAL AND METHODS: In this nationwide population-based cohort study 1997-2011, we examined the outcome of 770 births in women with CP vs. 1,247,408 births in women without a CP diagnosis using the Swedish Medical Birth Register. We used unconditional logistic regression, adjusting for maternal age, smoking, parity, year of birth and epilepsy, to calculate adjusted odds ratios for adverse pregnancy outcome. Main adverse outcome was preterm birth. Secondary outcomes were cesarean section, induction of labour, low 5-min Apgar score, small for gestational age, large for gestational age, and stillbirth. RESULTS: After adjusting for potential confounders, maternal CP was associated with increased risk of preterm birth (12.9% vs. 4.9%; adjusted odds ratio 2.8, 95% confidence interval 2.3 to 3.5), caesarean delivery (1.9, 1.6 to 2.2), induced delivery (1.4, 1.1 to 1.6), low 5-min Apgar score (1.8, 1.1 to 2.9) and small of gestational age birth (1.6, 1.2 to 2.3). We found no increased risk of large for gestational age or stillbirth. CONCLUSIONS: Women with CP are at increased risk of preterm birth and other adverse pregnancy outcomes, suggesting that they deserve extra surveillance during antenatal care. Further studies, with information on type of CP and gross motor function, are warranted in order to better understand the association between CP and pregnancy outcome.

PMID: 31738455

19. Impact of stroke volume on motor outcome in neonatal arterial ischemic stroke.
Wiedemann A, Pastore-Wapp M, Slavova N, Steiner L, Weisstanner C, Regényi M, Steinlin M, Grunt S; Swiss Neuropediatric Stroke Registry Group.

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BACKGROUND AND OBJECTIVES: Neonatal arterial ischemic stroke (NAIS) can lead to long-term neurological consequences such as cerebral palsy (CP). The aim of this study was to evaluate the predictive value of acute diffusion-weighted imaging (DWI) for CP by analyzing stroke volume next to brain structure involvement. METHODS: We included 37 term-born infants with NAIS prospectively registered in a nationwide pediatric stroke registry. DWI was performed between 0 and 8 days (mean 3 days) after stroke manifestation. Participants were neurologically assessed at the age of 2 years. We calculated the stroke volume (in mm3) and the ratio of the stroke volume to the volume of the entire brain (relative stroke volume). The predictive value of the relative stroke volume was analyzed and an optimal threshold for classification of children with high- and low-rates of CP was calculated. Predictive value of brain structure involvements and the prevalence of CP in combinations of different brain structures was also assessed. RESULTS: Sixteen children (43.2%) developed CP. Relative stroke volume significantly predicted CP ($p < .001$). Its optimal threshold for division into high- and low-rate of CP was 3.3%. The basal ganglia (OR 8.3, 95% CI 1.2-60.0) and basis pontis (OR 18.5, 95% CI 1.8-194.8) were independently associated with CP. CONCLUSION: In addition to determining the involvement of affected brain areas, the volumetric quantification of stroke volume allows accurate prediction of cerebral palsy in newborns with NAIS.

PMID: 31740218

20. From cerebral palsy to developmental coordination disorder: development of preclinical rat models corresponding to recent epidemiological changes.
Coq JO, Kochmann M, Lacerda DC, Khalki H, Delcour M, Toscano AE, Cayetanot F, Canu MH, Barbe MF, Tsuji M.

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Cerebral palsy (CP) is a complex syndrome of various sensory, motor and cognitive deficits. Its prevalence has recently decreased in some developed countries and its symptoms have also shifted since the 1960s. From the 1990s, CP has been

associated with prematurity, but recent epidemiologic studies show reduced or absent brain damage, which recapitulates developmental coordination disorder (DCD). In previous studies, we developed a rat model based on mild intrauterine hypoperfusion (MIUH) that recapitulated the diversity of symptoms observed in preterm survivors. Briefly, MIUH led to early inflammatory processes, diffuse brain damage, minor locomotor deficits, musculoskeletal pathologies, neuroanatomical and functional disorganization of the primary somatosensory (S1) cortex but not in the motor cortex (M1), delayed sensorimotor reflexes, spontaneous hyperactivity, deficits in sensory information processing, and memory and learning impairments in adult rats. Adult MIUH rats also exhibited changes in muscle contractile properties and phenotype, enduring hyperreflexia and spasticity, as well as hyperexcitability in the sensorimotor cortex. We recently developed a rat model of DCD based on postnatal sensorimotor restriction (SMR) without brain damage. Briefly, SMR led to digitigrade locomotion (i.e., "toe walking") related to ankle-knee overextension, degraded musculoskeletal tissues (e.g., gastrocnemius atrophy), and lumbar hyperreflexia. The postnatal SMR then led to secondary degradation of the hind-limb maps in S1 and M1 cortices, altered cortical response properties and cortical hyperexcitability, but no brain damage. Thus, our 2 rat models appear to recapitulate the diversity of symptoms ranging from CP to DCD and contribute to understanding the emergence and mechanisms underlying the corresponding neurodevelopmental disorders. These preclinical models seem promising for testing strategies of rehabilitation based on both physical and cognitive training to promote adaptive brain plasticity and to improve physical body conditions.

PMID: 31756523

21. Phenotype-genotype correlations in patients with GNB1 gene variants, including the first three reported Japanese patients to exhibit spastic diplegia, dyskinetic quadriplegia, and infantile spasms.
Endo W, Ikemoto S, Togashi N, Miyabayashi T, Nakajima E, Hamano SI, Shibuya M, Sato R, Takezawa Y, Okubo Y, Inui T, Kato M, Sengoku T, Ogata K, Hamanaka K, Mizuguchi T, Miyatake S, Nakashima M, Matsumoto N, Haginoya K.

Brain Dev. 2019 Nov 14. pii: S0387-7604(19)30051-8. doi: 10.1016/j.braindev.2019.10.006. [Epub ahead of print]
We report the first three Japanese patients with missense variants in the GNB1 gene. Patients exhibited severe dyskinetic quadriplegia with cortical blindness and epileptic spasms, West syndrome (but with good outcomes), and hypotonic quadriplegia that later developed into spastic diplegia. Whole-exome sequencing revealed two recurrent GNB1 variants (p.Leu95Pro and p.Ile80Thr) and one novel variant (p.Ser74Leu). A recent investigation revealed large numbers of patients with GNB1 variants. Functional studies of such variants and genotype-phenotype correlation are required to enable future precision medicine.

PMID: 31735425

22. Autophagy-Related Gene 7 Polymorphisms and Cerebral Palsy in Chinese Infants.
Xia L, Xu J, Song J, Xu Y, Zhang B, Gao C, Zhu D, Zhou C, Bi D, Wang Y, Zhang X, Shang Q, Qiao Y, Wang X, Xing Q, Zhu C.

Front Cell Neurosci. 2019 Nov 5;13:494. doi: 10.3389/fncel.2019.00494. eCollection 2019.

Cerebral palsy (CP) is a group of non-progressive motor impairment syndromes that are secondary to brain injury in the early stages of brain development. Numerous etiologies and risk factors of CP have been reported, and genetic contributions have recently been identified. Autophagy has an important role in brain development and pathological process, and autophagy-related gene 7 (ATG7) is essential for autophagosome biogenesis. The purpose of this study was to investigate the genetic association between ATG7 gene single nucleotide polymorphisms (SNPs) and CP in Han Chinese children. Six SNPs (rs346078, rs1470612, rs11706903, rs2606750, rs2594972, and rs4684787) were genotyped in 715 CP patients and 658 healthy controls using the MassArray platform. Plasma ATG7 protein was determined in 73 CP patients and 79 healthy controls. The differences in the allele and genotype frequencies of the rs1470612 and rs2594972 SNPs were determined between the CP patients and controls (p allele = 0.02 and 0.0004, p genotype = 0.044 and 0.0012, respectively). Subgroup analysis revealed a more significant association of rs1470612 (p allele = 0.004, p genotype = 0.0036) and rs2594972 (p allele = 0.0004, p genotype < 0.0001) with male CP, and more significant differences in allele and genotype frequencies were also noticed between CP patients with spastic diplegia and controls for rs1470612 (p allele = 0.0024, p genotype = 0.008) and rs2594972 (p allele < 0.0001, p genotype = 0.006). The plasma ATG7 level was higher in CP patients compared to the controls (10.58 ± 0.85 vs. 8.18 ± 0.64 pg/mL, p = 0.024). The luciferase reporter gene assay showed that the T allele of rs2594972 SNP could significantly increase transcriptional activity of the ATG7 promoter compared to the C allele (p = 0.009). These findings suggest that an association exists between genetic variants of ATG7 and susceptibility to CP, which provides novel evidence for the role of ATG7 in CP and contributes to our understanding of the molecular mechanisms of this neurodevelopmental disorder.

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